ON THE COMPUTATION OF ATMOSPHERIC TURBIDITY AND WATER VAPOR FROM SOLAR RADIATION MEASUREMENTS—A CORRECTION TO PREVIOUS NOTE

In a paper in the REVIEW for November 1936, page 377, appears the following statement:

> I was greatly shocked when I discovered that the mean of values derived from $I_y - I_r$ and from $I_m - I_y$ had been employed in determining the values of β for dry air. I very much regret this error for which I assume full responsibility.

However, at a conference with my former associates at the Weather Bureau, it has now been made clear that the supposed erroneous method was correct. Therefore, no corrections are necessary to earlier computed values of β.

In computing values of β from $I_y - I_r$, I made use of a method that Hoelper has criticised on the ground that $I_y - I_r$ is too small a number to give accurate results. In this case, however, after November 15, $I_y - I_r$ had been measured by a very accurate instrument. It is, therefore, believed that the value derived from $I_y - I_r$ may be accepted as reasonably correct.

Beginning with January 1937, curves published by Hoelper in the *Deutschen Meteorologischen Jahrbuch* for 1933, and which Feussner recommends, will be employed in the United States in computing both β and w by the method now followed at European observatories, except that for the present, at least, we shall compute w from the difference between I_m (dry) and I_m (observed).—*H. H. Kimball.*

BIBLIOGRAPHY

[RICHMOND T. ZOCH, *in Charge of Library*]

By AMY D. PUTNAM

RECENT ADDITIONS

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SOLAR OBSERVATIONS

SOLAR RADIATION MEASUREMENTS DURING DECEMBER 1936

By IRVING F. HAND, Assistant in Solar Radiation Investigations

For a description of instruments employed and their exposures, the reader is referred to the January 1935 REVIEW, page 24.

Table 1 shows that solar radiation intensities averaged below normal at Washington and Madison, and slightly above normal at Lincoln.

Table 2 shows a deficiency in the amount of total solar and sky radiation received on a horizontal surface at all stations with the exception of Madison, Fresno, New York, and Twin Falls. The percentage departures for the year show that all stations had an excess with the exception of Twin Falls, Miami, Riverside, and Blue Hill.

Beginning with this issue table 3 appears in a slightly different form containing two new columns, thus enabling the reader to better follow the method of computation. On the computation of β and w, see the November REVIEW, p. 377, and this REVIEW, p. 430.

Polarization observations obtained at Washington on 6 days give a mean of 55 percent with a maximum of 60 percent on the 5th. At Madison observations were obtained on 2 days only, the 4th and 31st, with values of 54 and 64 percent, respectively. All of these values are slightly below the corresponding normals for December.

TABLE 1.—*Solar radiation intensities during December 1936*

[Gram-calories per minute per square centimeter of normal surface]

WASHINGTON, D. C.

Date	Sun's zenith distance: 8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass: A. M.				[1] 1.0	P. M.				Local mean solar time
	e	5.0	4.0	3.0	2.0		2.0	3.0	4.0	5.0	e
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
Dec. 1	1.07	0.83	0.96	1.10	------	------	------	------	------	------	1.78
Dec. 4	4.57	.49	.68	.83	1.12	------	------	------	------	------	4.75
Dec. 5	2.74	.68	.87	1.07	1.24	------	------	------	------	------	2.49
Dec. 8	1.68	------	1.02	------	1.35	------	------	1.01	------	------	1.37
Dec. 17	6.27	.74	.87	1.00	1.10	------	------	------	------	------	5.56
Dec. 21	2.62	.85	.95	1.16	1.32	------	------	------	------	------	2.36
Dec. 22	2.26	.64	.75	.88	1.12	------	------	.89	0.76	0.63	2.36
Dec. 24	3.00	.79	.88	1.04	1.21	------	------	------	------	------	3.63
Means	------	.72	.87	1.01	1.21	------	------	(.95)	(.76)	(.63)	------
Departures	------	−.06	−.03	−.04	−.02	------	------	−.09	−.06	−.04	------

MADISON, WIS.

Dec. 4	1.52	1.00	1.18	1.29	------	------	------	------	------	------	1.32
Dec. 8	1.88	------	.56	.86	------	------	------	------	------	------	2.06
Dec. 11	.71	1.04	1.13	1.30	------	------	------	0.96	0.54	------	.96
Dec. 23	3.15	.68	.80	1.03	------	------	------	1.00	------	------	3.81
Dec. 31	1.96	------	------	1.20	------	------	------	------	------	------	1.96
Means	------	.91	.92	1.14	------	------	------	(.98)	(.54)	------	------
Departures	------	−.05	−.16	−.07	------	------	------	−.27	−.48	------	------

[1] Extrapolated.

TABLE 1.—*Solar radiation intensities during December 1936*—Contd.

LINCOLN, NEBR.

Date	Sun's zenith distance: 8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass: A. M.				[1] 1.0	P. M.				Local mean solar time
	e	5.0	4.0	3.0	2.0		2.0	3.0	4.0	5.0	e
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
Dec. 3	3.00	0.96	1.19	1.32	------	------	------	------	1.08	0.98	3.45
Dec. 10	2.16	.96	1.11	1.27	------	------	------	------	1.10	1.03	1.32
Dec. 11	2.06	.99	1.08	1.23	------	------	------	------	------	------	3.30
Dec. 16	3.99	1.03	1.14	1.30	------	------	------	------	------	------	4.37
Dec. 22	2.62	------	------	------	------	------	------	1.07	.91	.80	3.15
Dec. 23	3.45	.98	1.07	1.26	------	------	------	1.16	------	------	4.57
Means	------	.98	1.12	1.28	------	------	------	(1.12)	1.03	.94	------
Departures	------	+.04	+.03	+.05	------	------	------	+.08	+.04	+.02	------

BLUE HILL, MASS.

Dec. 1	1.1	0.83	0.95	1.07	------	------	------	------	------	------	1.5
Dec. 4	4.3	------	------	------	------	------	------	------	1.07	1.00	3.2
Dec. 5	2.0	1.01	1.11	1.23	1.36	------	------	1.17	1.02	.88	1.8
Dec. 8	.9	.94	1.08	1.12	------	------	------	------	------	------	2.8
Dec. 14	2.2	------	------	------	------	------	1.34	1.20	1.08	.98	3.2
Dec. 15	3.2	.81	.87	.88	------	------	1.17	1.17	------	.88	3.3
Dec. 17	6.1	------	------	------	------	------	1.25	1.08	.84	------	3.0
Dec. 18	1.5	1.10	1.16	1.25	1.38	------	1.38	1.25	1.16	1.06	1.3
Dec. 21	2.9	------	------	1.15	1.40	------	1.40	1.20	.96	------	2.3
Dec. 22	1.6	------	1.12	1.23	1.43	------	1.43	1.26	1.12	------	.9
Dec. 23	1.1	------	------	1.27	1.41	------	1.41	1.28	1.13	1.08	1.4
Dec. 28	7.9	------	------	1.13	1.24	------	1.29	1.36	1.29	1.18	3.2
Dec. 29	1.6	------	------	------	1.36	------	1.36	1.32	1.25	1.16	2.6
Means	------	.94	1.05	1.15	1.37	------	1.34	1.23	1.09	1.03	------

TABLE 2.—*Average daily totals of solar radiation (direct+diffuse) received on a horizontal surface*

Week beginning—	Gram-calories per square centimeter: Washington	Madison	Lincoln	Chicago	New York	Fresno	Twin Falls	La Jolla	Miami	New Orleans	Riverside	Blue Hill	San Juan	Friday Harbor	Ithaca
1936	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Dec. 3	120	122	139	78	118	204	123	258	299	156	225	99	456	54	80
Dec. 10	102	155	213	119	113	181	140	200	275	44	187	100	458	85	84
Dec. 17	162	142	140	109	129	66	126	249	290	261	244	160	419	59	80
Dec. 24	159	137	106	68	130	128	102	176	268	147	166	114	289	72	83
	Departures from weekly normals														
Dec. 3	−39	+6	−33	+9	+16	+13	+12	------	−5	−16	+12	−31	------	−26	−1
Dec. 10	−34	+42	+47	+79	+12	+2	+21	------	−33	−140	−30	−28	------	+10	+2
Dec. 17	+17	+22	−38	+21	+32	−83	+9	------	+10	+91	+21	+18	------	−12	−11
Dec. 24 [1]	+10	+14	−68	−17	+15	−10	−31	------	−15	−21	−54	−34	------	+4	−17
	Accumulated departures on—														
	+5,152	+4,564	+7,707	+11,613	+8,379	+4,550	−2,576	------	−8,827	------	−1,246	−1,638	------	+1,281	+987
	Percentage departure for year														
	+4.4	+3.8	+5.6	+18.0	+8.2	+2.7	−1.8	------	−5.7	------	−0.8	−1.3	------	+0.8	+0.8

[1] 8-day means.

ON THE METHOD EMPLOYED FOR COMPUTING β AND W, SEE P. 430 OF THIS REVIEW.—ED.

TABLE 3.—*Total, I_m, and screened, I_v, I_r, solar radiation intensity measurements, obtained during December 1936 and determinations of the atmospheric turbidity factor, β, and water-vapor content, w=depth in millimeters, if precipitated*

AMERICAN UNIVERSITY, WASHINGTON, D. C.

Date and hour angle	Solar altitude	Air mass	I_m	I_v	I_r	(*) $\frac{I_v}{0.851+C}$	(*) $\frac{I_r}{0.840+C}$	βI_{v-r}	(*) $\frac{I_{w-o}}{1.94}$	(*) $\frac{I_{w-o}-I_m}{1.94}$	w	Air-mass type
									Percentage of solar constant			
1936												
Dec. 4	° ′	*m*	*gr cal.*	*gr cal.*	*gr cal.*	*gr cal.*	*gr cal.*				*mm*	
1:04 a. m.	27 00	2.20	1.042	0.760	0.633	0.864	0.729	0.118	58.7	6.5	2.2	Pc
0:56 a. m.	27 25	2.17	1.063	.764	.637	.869	.733	.118	59.1	5.9	1.9	
Dec. 5												
1:20 p. m.	25 53	2.29	1.197	.907	.745	1.031	.857	.059	69.4	9.5	5.2	Pc
1:28 p. m.	25 19	2.33	1.191	.905	.746	1.030	.858	.060	69.6	10.0	6.9	
Dec. 8												
3:05 a. m.	14 56	3.84	1.039	.822	.686	.932	.787	.044	62.1	10.2	4.8	Pc
2:58 a. m.	15 36	3.68	1.083	.824	.688	.935	.789	.046	62.6	8.4	2.8	
1:20 p. m.	25 36	2.31	1.196	.883	.710	1.001	.815	.046	71.6	11.8	14.0	
1:25 p. m.	25 09	2.35	1.170	.885	.712	1.003	.818	.044	71.4	12.9	21.0	
Dec. 21												
2:58 a. m.	15 07	3.80	.985	.749	.630	.848	.722	.053	59.3	10.2	4.7	Np
2:55 a. m.	15 26	3.72	.971	.755	.634	.854	.727	.068	57.3	8.8	3.1	
0:49 a. m.	26 36	2.23	1.282	.944	.776	1.070	.890	.066	70.5	6.6	2.3	
0:45 a. m.	26 48	2.22	1.295	.944	.776	1.070	.890	.055	70.6	6.0	1.9	
Dec. 22												
3:12 a. m.	13 10	4.32	.699	.600	.521	.678	.596	.100	43.9	9.1	3.1	Pc
3:07 a. m.	13 50	4.12	.703	.609	.530	.689	.606	.104	44.7	9.6	3.7	
0:58 p. m.	26 11	2.26	1.052	.811	.681	.918	.780	.110	59.8	7.3	2.8	
1:01 p. m.	26 02	2.28	1.073	.807	.677	.915	.777	.106	60.0	6.5	2.2	
Dec. 24												
3:05 a. m.	14 06	4.04	.863	.699	.574	.791	.657	.050	58.8	15.8	38.0	Np
3:02 a. m.	14 30	3.94	.871	.709	.584	.802	.669	.055	58.2	14.8	28.0	

Atmospheric conditions during turbidity measurements

* Values reduced to mean solar distance.
Dec. 4. Temperature 3° C.; wind, NW 12; polarization, 53 percent; visibility, 20 miles; sky blueness, 5.
Dec. 5. Temperature 1° C.; wind, N. 12; polarization, 60 percent; visibility, 50 miles; sky blueness, 6.
Dec. 8. Temperature—4° C.; wind, N. 9; polarization, 51 percent; visibility, 30 miles; sky blueness, 5.
Dec. 21. Temperature 0° C.; wind, W. 14; polarization, 58 percent; visibility, 30 miles; sky blueness, 6.
Dec. 22. Temperature—1° C.; wind, NW. 12; polarization, 54 percent; visibility, 12 miles; sky blueness, 5.
Dec. 24. Temperature 0° C.; wind, S. 5; polarization, 54 percent; visibility, 30 miles; sky blueness, 6.

BLUE HILL METEOROLOGICAL OBSERVATORY OF HARVARD UNIVERSITY

Dec. 1												
3:43 a. m.	7 21		0.688	0.518	0.468	0.593	0.538					
2:47 a. m.	15 19	3.74	.984	.604	.596	.763	.671	0.090	51.0	1.8	0.9	Pc
Dec. 4												
3:46 p. m.	8 00		.728	.518	.456	.588	.527					Pc
Dec. 5												
3:04 a. m.	12 45	4.47	1.058	.712	.608	.731	.697	.050	62.0	9.1	4.7	
1:20 a. m.	22 56	3.56	1.244	.841	.690	.967	.793	.061	68.1	8.9	3.2	Pc
0:27 a. m.	25 09	2.35	1.288	.868	.716	.986	.824	.072	66.3	1.8	1.0	
3:29 p. m.	9 32		.840	.618	.536	.726	.615					
Dec. 8												
3:19 a. m.	11 40	4.85	.928	.652	.560	.745	.639	.090	48.0	3.6	1.7	Pc
Dec. 14												
0:33 p. m.	29 12	2.05	1.264	.856	.708	.973	.813	.065	70.5	13.0	9.2	
2:07 p. m.	19 15	3.02	1.200	.820	.684	.939	.792	.064	62.0	2.0	1.2	Np
Dec. 15												
1:16 a. m.	22 13	2.13	.952	.656	.560	.740	.639	.152	48.0	.5	.3	
0:44 p. m.	22 45	2.48	1.060	.730	.604	.827	.693	.152	59.1	6.5	2.6	Np
3:49 p. m.			.640	.496	.424	.562	.487					
Dec. 17												
2:51 p. m.	13 27	4.25	.688	.496	.404	.561	.462	.080	49.0	4.1	2.0	Npc
Dec. 18												
1:57 a. m.	19 52	3.06	1.268	.808	.706	.914	.808	.113	51.8	11.0	6.3	
1:00 p. m.	22 24	2.63	1.400	.936	.760	1.060	.870	.024	75.5	5.6	3.5	Pc
2:48 p. m.	13 55	4.25	1.116	.784	.640	.894	.733	.027	66.4	10.9	5.4	
Dec. 21												
2:13 a. m.	15 13	3.77	1.104	.776	.638	.876	.730	.045	61.6	6.5	3.4	
2:02 p. m.	18 33	3.13	1.118	.808	.664	.912	.759	.065	61.3	2.5	1.4	Np
Dec. 22												
1:33 a. m.	21 06	2.68	1.296	.880	.724	.992	.826	.090	73.0	8.3	5.1	
0:19 a. m.	24 11	2.45	1.388	.936	.761	1.056	.869	.080	77.0	8.0	5.2	Pc
Dec. 23												
1:48 a. m.	19 46	2.93	1.296	.872	.720	.983	.800	.080	69.6	4.5	2.7	
0:23 a. m.	24 10	2.43	1.344	.888	.732	1.001	.834	.062	69.2	2.0	1.3	Pc
2:46 p. m.	13 57	4.74	1.104	.748	.700	.845	.807	.052	57.8	5.4	3.1	
Dec. 24												
1:58 a. m.	23 16	2.52	.914	.656	.558	.742	.639	.156	50.2	4.6	2.9	Np
Dec. 28												
1:45 a. m.	20 17	2.86	1.144	.784	.640	.888	.734	.062	66.4	6.0	3.6	
0:47 a. m.	23 35	2.49	1.240	.836	.680	.946	.781	.062	67.2	3.4	2.2	Np
Dec. 29												
0:41 a. m.	23 42	2.48	1.336	.892	.728	1.008	.832	.083	69.2	2.6	1.7	
12:00 noon	24 32	2.41	1.344	.892	.732	1.008	.837	.061	69.0	2.0	1.3	Pc

Atmospheric conditions during Smithsonian Observations December 1936

Date	Time from apparent noon	Temperature °C.	Wind, Beaufort	Visibility	Sky blueness	Cloudiness and remarks
Dec. 1	3:36 a. m.	−13.1	NNW 3	6	6	Few Cu; moderate to dense haze; instrument indoors.
5	3:19 a. m.	−2.8	NW 4	7	9	Zero clouds; moderate haze; instrument indoors.
5	0:08 p. m.	+.7	NW 5	8	8	1 Ci; light haze; Frcu near sun.
8	3:26 a. m.	−11.3	NE 3	6	9	Trace Acu; dense haze.
14	1:15 p. m.	+1.3	SW 2	7	9	2 Ci; moderate haze; instrument outdoors.
15	1:52 a. m.	+4.1	W 4	6	8	Zero clouds; dense haze.
18	2:10 a. m.	−6.8	NW 5	9	10	Zero clouds.
22	0:53 a. m.	−5.6	NW 6	9	11	Trace Cu.
22	0:26 a. m.	−6.1	NW 5	9	11	Trace Cu and Frcu.
23	0:56 a. m.	−6.9	WNW 3	8	10	Trace Ci.
24	2:09 a. m.	+1.4	SW 4	5	8	2 Ci; dense haze.
28	1:20 a. m.	+8.3	WNW 6	8	10	Trace Cist; trace Cu; moderate haze.
28	0:35 a. m.	+8.3	WNW 6	8	10	Trace Cist; Trace Cu; moderate haze.
29	0:37 a. m.	+2.8	ENE 3	8	9	4 Ci, moderate haze to NE.

POSITIONS AND AREAS OF SUN SPOTS

Note.—The reports for November and December 1936, not having been received in time, will be included in the January 1937 issue of the REVIEW.—*Ed.*

PROVISIONAL SUN-SPOT RELATIVE NUMBERS, DECEMBER 1936

[Dependent alone on observations at Zurich and its station at Arosa]

[Furnished through the courtesy of Prof. W. Brunner, Eidgen. Sternwarte, Zurich, Switzerland]

December 1936	Relative numbers	December 1936	Relative numbers	December 1936	Relative numbers
1	*bdd* 193	11	*d* 82	21	*dd* 86
2	*b* ---	12	*Wc* 76	22	117
3	*a* ---	13	*d* 74	23	130
4	---	14	71	24	*Eaccd* 149
5	158	15	40	25	151
6	*Ec* 146	16	43	26	*a* 150
7	*aa* ---	17	*Wac* 70	27	*a* 151
8	*Ec* 134	18	*d* 88	28	*ad* 135
9	104	19	*a* 85	29	*Eacd* 167
10	*a* 107	20	74	30	*Eac* 200
				31	181

Mean, 27 days = 117.5.

a = Passage of an average-sized group through the central meridian.
b = Passage of a large group or spot through the central meridian.
c = New formation of a group developing into a middle-sized or large center of activity: E on the eastern part of the sun's disk; W, on the western part; M, in the central circle zone.
d = Entrance of a large or average-sized center of activity on the east limb.

AEROLOGICAL OBSERVATIONS

[Aerological Division, D. M. LITTLE, in charge]

By L. P. HARRISON

Mean free-air temperatures and relative humidities for December, as determined from airplane weather observations, are given in table 1. The "departures from normal" given in the table are based on "normals" derived from the number of observations indicated in the note at the foot of the table, where the numbers of years over which the observations were taken are given by the figures in parentheses. In general, the numbers of observations available for computing "normals" for the higher levels are less than those available for the lowest levels (represented by the data given in the footnote). To compensate for this discrepancy, the "normals" are obtained by applying the mean differences between the successive standard levels to the data for the lower levels, where the "normal" for the surface based on the indicated number of observations serves as the reference basis. The "normals" in each case include the data for the current month. It will be noted that many of the "normals" are based on only three years of observations. "Departures from normal" in such cases must be regarded as having little weight in comparison with departures from "normals" based on much more extended periods of record (35 or more years, say, which are not uncommon in climatology).

The mean temperatures for the month at the surface (see chart I) were above normal over practically the entire country. The greatest positive departures from normal temperature at the surface were to be found largely in the central part of the country, the southern portion of the Great Lakes area, the coastal strip extending approximately from Massachusetts to New Jersey, and also a small region from eastern Washington to western Montana. Departures in these areas generally were from +1.5° to nearly +3.5° C. Small regions of negative departure from normal were to be found in parts of northern and central California as well as eastern Montana.

The mean temperatures for the month in the free air (see table 1) were largely above normal in the eastern third, and in a portion of the central part, of the country. The greatest positive departures from normal temperature in the free air were largely concentrated in the area encompassed by the stations at Boston, Lakehurst, Mitchel Field, Scott Field, and Wright Field, where the departures for these respective places ranged as follows in the free-air levels for which data were available: +3.4° to 4.6° C., 2.6° to 5.5° C., 4.4° to 6.9° C., 1.4° to 3.8° C., and 2.7° to 4.7° C.

Negative departures from normal free-air temperatures during December were generally small in magnitude and were mostly confined to the western third of the country with extensions in the north-central and south-central areas. The negative departures were most pronounced at Spokane and San Diego (−0.8° to −3.5° C., and −1.1° to −2.3° C., respectively).

Mean monthly free-air relative humidities during the month under review were appreciably below normal in the eastern third of the country at all levels except those within 0.5 to 2 km of the ground in some cases, where above-normal humidities prevailed in a slight degree. The region of most marked negative departure from normal relative humidity could be identified with the region of greatest positive departures from normal of temperature referred to above. This condition was most pronounced in the levels from about 1.5 to 4 km above sea level, where departures as great as −16 to −18 percent occurred at Lakehurst, Mitchel Field, and Wright Field. (It is possible that these values are somewhat greater than they should be, owing to the lack of a full month's observations—19, 18, and 20 observations, respectively, being actually available—and the absence of data principally for days with low clouds, precipitation, etc.) The layer of marked subnormal humidities occurred at somewhat lower elevations in the southwestern portion of